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(54) Title: SYSTEM FOR CHARGING THE USE OF A PACKET–BASED TELECOMMUNICATION NETWORK
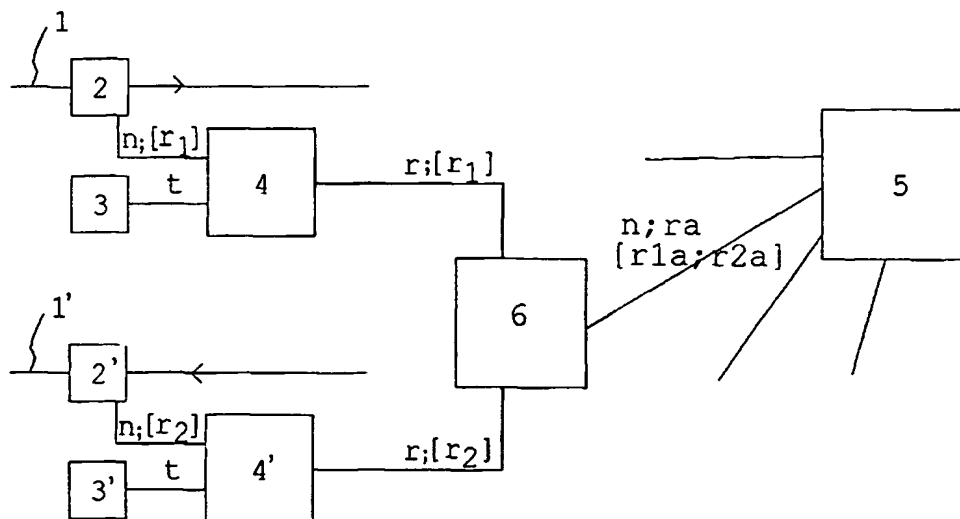
(57) Abstract

System for charging the use of a packet based telecommunication network. A measuring device (2) measures the number (n) of data units during a period of time (T) or the period of time (t) between a certain number (N) of data units. At any rate, the period of time is short in relation to the total connection time. A calculation device (4) calculates per period of time the number of data units per unit of time and transmits that calculation result (r) to a billing system (5). If the telecommunication system comprises system data units which comprise an indication (r1) of the capacity or priority requested by the user, that indication can also be passed on to the billings system, as well as an indicaton of the capacity or priority assigned by the telecommunication system.

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System for charging the use of a packet-based
telecommunication network.

BACKGROUND OF THE INVENTION

5   The invention is related to a system for charging the use
of a packet-based telecommunication network, such as an ATM
or IP oriented network.
a. ATM (Asynchronous Transfer Mode)
ATM is a relatively new network technique for supplying
10   connections with very different characteristics in a
uniform manner. For each ATM connection has to be paid.
Preferably, the amount charged for the connection reflects
both the performance delivered by the network and the
performance experienced by the customer. In a telephone
15   network something like this is achieved by letting the
amount to be dependent on the duration of the connection
(calculated in seconds, minutes or other units, such as
"ticks") and on the distance covered. A telephone call,
however, is almost always a case of a connection with a
20   fixed capacity (e.g. 64 kbit/s with ISDN). In contrast, ATM
is much more flexible and there are more connection
parameters and variables than with PSTN or ISDN based
connections.
- With ATM connections can be established with varying
25   capacity (some kbit/s up to hundreds of Mbit/s).
- With ATM connections can be established with varying
network garantuees concerning cell loss, cell delay, cell
delay variance and throughput by choosing an "ATM Transfer
Capability" (ATC) [2] and Quality of Service class (QoS
30   class) [3]. The amount charged for an ATM connection should
preferably also reflect this additional flexibility, which
is the subject of the present invention. An important
aspect in determining the manner of charging for ATM
connections is the direction (incentive) that the charging
35   gives to the manner of network usage. In a traditional
telephone network the time-related charge usually assures

that the customer does not unnecessarily occupy the the connection. In a traditional data network usually a volume rate is used, so that there is an incentive not to burden the network with unnecessary traffic. Another example is

5 the application of an off-peak rate with a view of shifting a part of the network traffic to periods outside the peak hours so that the network can be dimensioned smaller and thereby is less expensive.

The present state of the art usually envisages to base the

10 charge of an ATM connection on two variables, i.e. a time component, the duration of time of the connection (session), and a volume component, the total number of ATM cells transmitted and/or received during the connection [1]. Both variables can easily be measured, registered and

15 processed into a charge during the connection. On processing of the values of the time component the price per unit can depend on various quantities. Examples of such quantities are the distance covered and time of the day or of the week, comparable with the usual charging for

20 telephone. Examples of other quantities are the ATM parameters such as the Peak Cell Rate of the connection etc.

There are different ATCs standardised in ITU-T recommendation I.371. Hereafter it is indicated what are

25 the limitations for some of the ATCs of choosing a charge which is based on the time and volume component as described in the above.

A charge which is exclusively based on the time and volume component as set out in the above, has as a consequence

30 that only the total connection duration and only the total number of cells during the duration of the connection play a role in the charge. For these quantities (and thereby for the charge) it does not matter whether all cells are offered evenly over the connection duration ("Constant Bit

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Rate") or are concentrated in one or more bursts of cells ("Variable Bit Rate"). For the network it is advantageous if the cells offered are spread as much as possible. ATM connections that use SBR (Statistical Bit Rate) are

5 characterised by two additional parameters, the Sustainable Cell Rate (SCR) and the Maximum Burst Size (MBS). The essence of the situation set out above does not change, however: the user experiences no incentive to spread the cells as much evenly as possible, while this is beneficial

10 for the total network capacity and consequentially is pursued by the network operator. The question is thus in which way the user can be urged to offer the traffic as evenly as possible. In other words, a method is needed to urge the network user via the charging mechanism to offer

15 the traffic in a less bursty way. If in an ATM network use is made of an ABR (Avaialable Bit Rate) control mechanism, the network dynamically assigns capacity to each connection. It can however occur that the network assigns capacity to a connection but that the user does not use or

20 not comletely use that capacity., e.g. if the user sends less cells than the assigned capacity allows. With the present charging mechanisms (based on a total time and a total volume component in the charge), leaving capacity assigned by the network unused leads to a lower charge.

25 There is no incentive to use the assigned capacity indeed and there is no incentive to gear the capacity to the actual current need.
b. IP (Internet Protocol)
The IP is a connectionless packet switched technique which

30 is used for the Internet. Current IP networks exclusively supply a so-called best-effort service. The networks commits itself to make an effort to deliver the packet (datagramme) at the destination but no guarantee is given; the packet can be lost in case of a congestion. It is

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customary to charge access to the Internet only, e.g. by a
fixed amount per month (flat rate) or by a fixed rate per
unit of time (hour) that the user is logged onto his
Internet Sevice Provider. In this type of charging there is
5   no relation with the amount of data wich a user asks or
offers.
Because IP is a connectionless technique, there is no
matter of "connections" in the same sense as with a
telephone or an ATM connection. The aspect of time is
10   therefore inherently unsuitable to serve as measure for
network load. To be able to relate the use of an IP network
to the network load caused by the network user, an other
quantity has to be used.
The amount of data can in IP be expressed in different
15   units, such as the number of datagrammes per unit of time
and the number of bytes (or bits) per unit of time of which
the datagrammes consist.
Guaranteed IP services
Recently, work is being done on an extension of the
20   services which an IP network can offer. The aim is, next to
the best-effort service described in the above, to also
enable an IP network to give guarantees for the throughput
and for the delay experienced in the network, comparable
with the possibilities that an ATM network offers. The
25   standardisation of these new services with guarantees is
still in an early stage.
One of the proposed possibilities is to use reservations,
e.g. with the protocol RSVP [4]. In that case it is
desirable that the extent of the reservation requested or
30   made and the duration of the reservation is expressed in
the charge.
In an other proposed approach, some bits in the IP header
are used to indicate to which service class the IP packet
belongs, e.g. "best-effort" or "guaranteed with short

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delay". In that case it is desirable that the indication of
the service class also is expressed in the charge.
All considerations as mentioned above for ATM/DBR and
ATM/SBR are mutatis mutandis also applicable on these new

5   IP services with guarantees.
SUMMARY OF THE INVENTION
The invention provides a charging system in which the
charging gives more direction to an efficient network use.
To this end, the invention proposes not to measure and

10   charge the total numbver of data units (cells, IP
datagrammes, bytes in IP datagrammes) during the whole
connection (session), but to subdivide a connection in
shorter or longer measuring periods, to measure the number
of data units during such measurement periods and base the

15   charging on that. The invention comprises hereunto a
measurement device for measuring the number of data units
received and/or transmitted during a set period of time,
shorter than the time during which said telecommunication
connection is open or active. In stead of measuring the

20   number of data units over a fixed period, it is conversely
also possible to measure the duration of time between the
reception or transmission of a specific number of data
units. Furthermore, the invention comprises a calculation
device for calculating for each set or measured period of

25   time the number of data units per unit of time and offering
that calculation result a billing system. The calculation
device calculates thus per û shorter or longer û period the
real data units / time ratio, whereby the billing follows
the actual network load more accurately. Thus, for the user

30   an incentive can be created not to offer the data in bursts
but more evenly and thereby contributing to a more
efficient network use.
The measuring period can be equal to the interarrival time
of two consecutive cells of a same connection. The rate

over the period from ti til and including ti+1 is then
equal to 1/(ti+1 û ti), in other words, the inverse of the
difference of the arrival and send times of two consecutive
cells. The measuring period can also be longer, e.g. the
time between cell number i and cell number i+n, where n>1.
The measuring period can also be a set period, e.g. 100 ms.
It will be appreciated that the shorter the measuring
period is, the more accurate the measurements are, but also
the larger the calculation capacity of the charging
computer has to be. Also, it requires transmission traffic
between the charging measurement points and the charging
computer.
Registering all measured information for all connections
can lead to a large amount of data between the registration
device and the billing system. A decrease of the amount of
data can be achieved by aggregating the data in an
aggregation device and transmitting the aggregated data to
the billing system.
If a data stream is controlled by the ABR mechanism in ATM,
the cell rate assigned (dynamically) by the network is
mentioned in the ECR field (Explicit Cell Rate) of
so-called backward RM cells. To base the charge, apart from
the real transmitted cell rate per measuring period, as
proposed in the preceding, also on the capacity assigned by
the network, the system can be extended by a device which
reads the value that is written in the ECR field. In the
same way, the cell rate desired by the user, mentioned in
the ECR field of the so-called forward RM cells, can be
detected and processed. In that way, the charging is based
both on the capacity desire of the user and on the capacity
which the network assigns to the user. A comparable
function is accomplished in an IP network by reading and
registering the size of the reservations desired or made
from the reservation messages (e.g. RESV messages of RSVP

[4]), or by reading and registering the priority indication in the header of the IP datagramme, and adjusting the charge accordingly.

DESCRIPTION OF THE FIGURE

5   Figure 1 shows an exemplary embodiment of the invention.
ATM: Asynchronous Transfer Mode

A physical communication line 1 transports ATM cells. The cells can belong to different virtual connections (channels, paths). A measuring device 2 detects from the

10 header of an arriving cell the virtual connection to which the cell belongs. In the measuring device 2 for each (virtual) connection a counter reading is kept up to date with the number of arriving cells. A clock generator 3 generates periodical clock pulses. A calculation device 4

15 calculates per connection the ratio between the number of arrived cells and the number of clock pulses and passes this ratio on to a billing system 5. According to the invention, said ratio is not calculated over the entire time that a connection is active but over smaller periods.

20 There are therein two possibilities, viz. (per connection) starting from a fixed measuring period T and counting the number n of cells arriving in that period, wherein the ratio r = n/T, or starting from a fixed number of cells N and measuring the time t which is needed for the arriving

25 of those cells, wherein r = N/t.
In order to charge a bursty supply of cells more heavily than an even supply, the fixed periods of measurement T or the fixed number of cells N is chosen in such a way that the ratio n/T or N/t is high in traffic with a (temporary)

30 "burst" character. To create an incentive for an even traffic supply, measurement periods in which the calue of r is high are charged more heavily than periods with a low value of r.

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In order to let the billing, in a connection which uses
ABR, also be dependent on the capacity desired by the user,
that value r1 is read by device 2 from passing RM (Resource
Management) cells and passed on, through the calculation
5   device 4, to the billing system 5. In the same way a value
r2 is extracted, via a return connection 1', in which
measuring device 2', a clock generator 3' and a calculation
device 4 are included, from the "backward" RM cells, which
is an indication for the maximum cell rate which is
10   (dynamically) assigned by the network to the user. That
value too, is passed on to the billing system and is
included, as well as the value r1, in the price to be
charged to the user.
For use in an IP network (where the packet size may vary)
15   the measuring device (2) is moreover able to measure and
register the size of the packet (datagramme). The
registration includes then the number of IP datagrammes and
the cumulative number of bytes in those datagrammes. A
calculation device 4 calculates per connection the ration
20   between the number of arrived datagrammes/bytes and the
number of clock pulses and passes both ratios on to a
billing system 5. In the same way, via a return connection
1', in which a measuring device 2', a clock generator 3'
and a calculation device 4 are included, a value r2 is in
25   the opposite direction extracted from the reservation
messages, which is an indication for the reservation
promised by the network. That value too is passed on to the
billing system and is included, as well as the value r1, in
the price to be charged to the user. Instead of relating to
30   the capcity, the parameters r1 and r2 can also relate to
the (requested or assigned) priority of the datagrammes.
Optionally, as the figure shows, an aggregation device 6
can be added. This device aggregates the periodically
generated data from the calculation devices 4 and 4', so

that the task of the billing system 5 is relieved and the quantity of billing data to be transported is reduced.

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[3] ITU-T I.356: "B-ISDN ATM layer cell transfer performance"; ITU-T recommendation I.356 (10/96); Geneva, October 1996.

[4] Braden, R. (Ed.), et al: "Resource ReSerVation Protocol (RSVP) Version 1, Functional Specification"; Internet Engineering Task Force, RFC 2205, September 1997.

CLAIMS

1. System for charging the use of a packet based telecommunication network such as an ATM or IP network, characterised by a measuring device (2) for measuring the
5   number (n) of data units received and/or transmitted data units during a set period of time (T), shorter than the time during which said telecommunication connection is opened.

2. System for charging the use of a packet based
10 telecommunication network such as an ATM or IP network, characterised by a measuring device (2) for measuring the time period (t) between a set number (N) of received or transmitted data uits.

3. System according to claim 1 or 2, characterised by a
15 calculation device (4) for calculating the number of data units per said period of time (T;t) and supplying that calculation result (r)to a billing system (5).

4. System according to claim 3, in which the telecommunication network comprises system data units
20 (RM,RESV) which comprise an indication (r1) of the capacity or priority requested by the user, characterised by a detection device (2) for reading out said indication out of the system data units and transferring that indication to the billing system.

25 5. System according to claim 3, in which the telecommunication system comprises system data units (RM, RESV) which comprise an indication (r2) of the capacity or priority assigned by the telecommunication system, characterised by a detection device (2') for reading out
30 said indication out of the system data units and transferring that indication to the billing system.

6. System according to claim 3, characterised by an aggregation device (6) for aggregating the calculation

result (r) en passing on the aggregated result (ra) to the
billing system.

7.   System according to claim 4 or 5, characterised by an
aggregation device (6) for aggregating said capacity or
5   priority indications (r1, r2) and passing on the aggregated
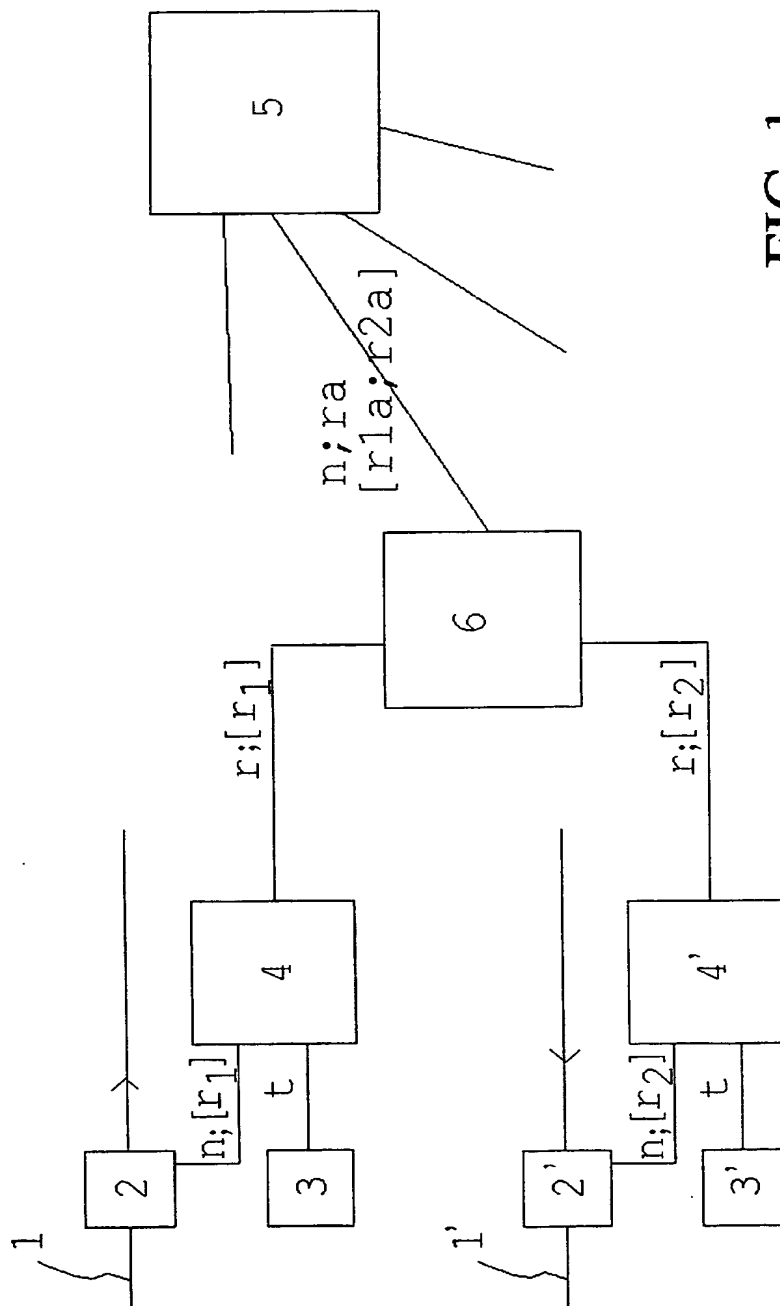indications (r1a, r2a) to the billing system.

FIG. 1

INTERNATIONAL SEARCH REPORT

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6   H04L12/14   H04Q11/04   H04L29/06

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6   H04L   H04Q

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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X	Further documents are listed in the continuation of box C.		X	Patent family members are listed in annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
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C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT		
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